

THE ACADEMIC AND PROFESSIONAL PREPARATION
OF THE BEGINNING HIGH SCHOOL BIOLOGY
TEACHERS IN KANSAS

by

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THE PROBLEM AND DEFINITIONS OF TERMS USED

During the last decade there has been a growing concern for improving the quality of science at the secondary level. Increasing emphasis has been placed on better teacher preparation at the college level. This study was made to investigate the academic and professional preparation of the beginning high school biology teachers in Kansas.

THE PROBLEM

Statement of the problem. It was the purpose of this study to (1) determine the nature and extent of the beginning high school biology teacher's professional and academic training and (2) determine the relationship between the academic and professional training of beginning high school biology teachers and the size of schools in which they taught.

Need for the study. The concern for better preparation of teachers in the field of science and mathematics has been growing during the last decade. This concern has recently been intensified considerably as the result of new developments both nationally and internationally. Professional educators, industrialists, government policy makers, college curriculum planners, and other civic-minded groups have become to realize that if our nation is to provide the

scientists that our society is demanding, then the supply of prospective scientists must be augmented at its source. The source being recognized as the secondary schools of our country.

Maul, assistant director of the National Education Association's division, has stated:

Slowly the realization is growing that it is in the high schools that talents are or are not identified, that native ability in certain fields is or is not nurtured, that the ambition to further study is or is not fired, and that careers in science are or are not chosen. In short, the high school (more accurately the high school teacher) is being recognized as the key to any successful effort to increase the supply of raw materials from which engineers and scientists are made.¹

The foregoing statements point out the crucial role of science teachers in the secondary schools. It becomes obvious why there has been increased concern for educating qualified science teachers. This concern was manifested in studies made by Ridgway² in 1931, Irwin³ in 1938,

¹Ray C. Maul, "Is the Science Teacher Shortage a Curriculum Factor?," The Science Teacher, 23:182.

²C.W. Ridgway, "A Comparative Study of the Training and Teaching Combinations of Kansas High School Teachers," Kansas State Teachers College Bulletin of Information, 5:1-31.

³Frank L. Irwin, "A Comparative Study of the College Preparation, Teaching Combinations, and Salaries of Kansas High School Teachers, (1938), " Kansas State Teachers College Bulletin of Information, 18:1-38.

Lockard⁴ in 1946, and Baker and Brooks⁵ in 1957. In an effort to compare the college preparation, teaching combinations, and salaries of Kansas high school teachers, they found that a large number of science teachers were insufficiently prepared for the science they were teaching.

The launching of a Russian satellite in 1957 gave new impetus to the field of science in America. The Federal government passed the National Defense Education Act which granted funds for science education. The National Science Foundation through its science and mathematics teacher institutes and the American Association for the Advancement of Science through its science teaching improvement programs sought to upgrade American science education. Changes in state certification laws and college graduation requirements were aimed at improving the quality of the science teacher.

However, these efforts to improve the quality of science teachers did not directly affect the existing teachers in our schools. Under the present conditions, teachers in Kansas are protected from changes in certifi-

⁴Gene K. Lockard, "A Comparative Study of the College Preparation, Teaching Combinations, and Salaries of Kansas High School Administrators and Teachers, (1946)," Kansas State Teachers College Bulletin of Information, 26:1-38.

⁵Weldon N. Baker, and Merle E. Brooks, "Background and Academic Preparation of the Teachers of Science in High Schools of Kansas, (1956-57)," The Emporia State Research Studies, 6:1-40.

cation laws by the following clause which is found in the
Kansas Certification Handbook:⁶

Any person qualified and teaching any subject during the 1958-1959 school year shall remain eligible to teach that subject even though advanced requirements are not met, provided the teacher remains in the same position and school.

Since the summer science institutes are voluntary, and the changes in graduation requirements affect only the new teachers, it appears that there will be a good number of inadequately qualified science teachers remaining in our schools.

This poses the question of whether or not our colleges and universities are still graduating inadequately qualified science teachers into our school systems.

An attempt was made in this study to determine the quality of the biology teachers who have come into our Kansas high schools during the last three years. A study of this type should prove helpful to colleges and universities in evaluating the academic and professional preparation of their biology teachers.

DEFINITIONS OF TERMS USED

Beginning high school biology teacher. A teacher who received a college degree in either 1961, 1962, or

⁶Kansas State Board of Education, Certification Handbook, (Topeka: State Board of Education, 1961), p.66.

1963, and is presently teaching biology in a Kansas high school.

Science field. The science field includes courses in biology, chemistry, physics, mathematics, and related sciences.

Related sciences. The related sciences include courses in astronomy, geology, and meteorology.

Part-time science teacher. A part-time science teacher is one who teaches at least one or more courses in the science field, and one or more courses outside the science field.

Full-time science teacher. A full-time science teacher devotes all his teaching time to the science field.

Full-time biology teacher. A full-time biology teacher devotes all his time to the area of biology.

Biology field. The biology field is made up of the following areas:⁷

Area A: Principles of biology: characteristics of living organisms, cell theory, structural system of plants and animals, metabolism, maintenance of individual (health and disease).

Area B: Plant and animal physiology, anatomy and morphology: comparative study of functional processes of cells and tissues, structure, and behavior among the major groups of plants and animals, including the micro-organisms.

Area C: Ecology and conservation: environment, soil populations, relationships of species, distributions of communities.

Area D: Development anatomy and genetics: growth and development, principles of heredity, evolution.

Area E: Preparation and use of biological materials: problems of microtechnique, cell and tissue culture, field collections, and preparation and care of small organisms.

General education. General education includes all course work taken in the areas of oral and written communication, literature and language, and social sciences.

Professional education. Professional education includes all courses outside the areas of science and general education and are aimed at preparing the teacher for the classroom.

Credit. The number of semester hours earned during college preparation.

ORGANIZATION OF THE REMAINDER OF THE REPORT

The main sections which are included in the remainder of this report are organized as follows: a

⁷Guidelines for Preparation Programs of Teachers of Secondary School Science and Mathematics, A Report Prepared by the National Association of State Directors of Teacher Education and Certification and the American Association for the Advancement of Science (Washington, D.C.: AAAS, 1961), p. 1-16.

review of the literature on college programs for the preparation of biology teachers, procedures used, analysis of the professional and academic training, and conclusions and recommendations.

REVIEW OF THE LITERATURE

The realization of the importance of science in the education of young people has resulted in many studies into the academic and professional background of science teachers. The results of these studies were to be used in evaluating certification requirements of science teachers. Very little has been written about the preparation of beginning science teachers.

LITERATURE ON THE PREPARATION OF BIOLOGY TEACHERS

As part of a study made in 1950, Nelson⁸ analyzed the academic training of the beginning biology teachers in the state of Illinois. The sixty-three subjects used in this study were Illinois science teachers who were teaching for their first, second or third year in high schools. Their range of training in science subject matter was found to be from twelve to ninety-five semester hours with the median at forty-seven hours. In the field of biology these

⁸T.A. Nelson, "What Administrators Want in the Training of Science Teachers and the Actual Training of Beginning Biology Teachers in the State of Illinois," Science Education, 40:24-43.

teachers had received from three to seventy-seven semester hours of training, the median falling at twenty-five hours. Of the sixty-three teachers in this group, fourteen were without training in chemistry, and twenty-three lacked any training in physics. Eleven had taken neither physics or chemistry during their training. It was also discovered that eighteen of the biology teachers had carried less than a minor in biology during their training period.

Biology training in this study constituted any course work taken in the following areas: general biology, zoology, botany, ecology, bacteriology, and physiology. It was clearly revealed that training for many biology teachers was not uniformly distributed over the field of biology. Some teachers lacked training in zoology; others had no credits in botany; some had only negligible amounts of training in either field, compared to their credits in other areas of biology.

In 1957 Baker and Brooks⁹ conducted a survey to determine the academic preparation in individual course work, degrees, employment, age, salary, and teaching combinations of the science teachers in Kansas. The results showed that 37.6 per cent of the teachers majored in a science field in college. The remaining 62.4 per cent majored in non-science fields. Teaching combinations of

⁹Baker and Brooks, op.cit., p. 1-40.

the teachers were multiple and varied. There were only fifty full-time biology teachers out of the 539 who taught biology. The most common combination was general science and biology.

The academic preparation of the science teachers was analyzed in terms of the authors' arbitrarily chosen basic science courses. These basic science courses were considered essential for the effective teaching of science. Of the biology teachers, 66 per cent had credit in zoology, 52 per cent in botany, and 13 per cent in field biology. In supporting courses, 68 per cent of the biology teachers had credit in Chemistry I, 46 per cent in Chemistry II, 27 per cent in organic chemistry, 58 per cent in Physics I, 30 per cent in Physics II, and 3 per cent in modern physics.

Koelsche¹⁰ made a survey of the academic preparation of the science teachers in Ohio in 1957. The results showed that there were 143 part-time and 97 full-time teachers offering biology in the 175 high schools investigated. Approximately 99 per cent of these teachers had some science credits in their collegiate backgrounds. This varied all the way from six semester hours in one area to 110 credits in three. The median number of credits earned by the 240 biology teachers in the combined science areas

¹⁰Charles L. Koelsche, "The Academic and Teaching Backgrounds of Secondary Science Teachers in the State of Ohio," Science Education, 43:134-139.

was thirty-three. Divided into part-time and full-time groups, their respective medians were twenty-eight and forty-five.

Seventy-five per cent of the biology instructors had 21 or more credits in science, but the nature and depth of the areas pursued varied greatly. Biology was included in the academic backgrounds of 97.1 per cent of the instructors teaching this subject. The median number of credits earned was twenty-four. Chemistry was included in the academic backgrounds of 51 per cent of the biology teachers. The median number of credits earned was thirteen. Physics was included in the academic backgrounds of 32 per cent of the instructors teaching biology. The median number of credits earned was nine. Courses in earth science were included in 20.9 per cent of biology instructors. The median number of credits was four. Full-time teachers were on the whole better prepared than part-time teachers. The areas of preparation arranged according to the descending strenghts were biology, chemistry, physics, geology, and astronomy (earth science).

In 1961 the National Association of State Directors of Teacher Education and Certification (NASDTEC) and the AAAS conducted a survey¹¹ to determine the service loads

¹¹NASDTEC, and AAAS, Secondary School Service and Mathematics Teachers, (Washington: U.S. Government Printing Office), 1-45.

and characteristics of secondary school science and mathematics teachers. The sample for this study was drawn from teachers of science and mathematics classes in the public and private secondary schools of the United States. The raw data were obtained from questionnaires which were sent to members of the sample. The results showed that fifty per cent of the biology teachers had thirty or more credits in the area of biology. Using eighteen credits as a minimum standard of adequacy of preparation, the study revealed that seventy-three per cent of the biology teachers met such a standard. The results of the number of credits in supporting fields of science were not published.

LITERATURE ON COLLEGE PROGRAMS FOR THE PREPARATION OF BIOLOGY TEACHERS

Novak and Brooks¹² (1959) recorded the judgments of 196 high school teachers of science as to the preparation necessary to teach high school science. They found the teachers' recommendations modest in terms of required college preparation, but even their modest recommendations exceeded state certification requirements. Results of this study also showed that many science teachers were satisfied with little or no basic course work in science subjects which they taught in high school.

¹²Joseph D. Novak, and Merle E. Brooks, "College Preparation of Science Teachers," Science Teacher, 26:473.

Consideration of the following developments point out that there is no room for such laxity in science teacher preparation.

Astronomy, biology, chemistry, geology, mathematics, meteorology, and physics have all advanced considerably in the last ten years. Mass communication brings these advances right into the student's home. Teachers must be prepared to stimulate the inquiring minds of the students. Teachers of science should take course work which prepares them to keep abreast of the new developments which are often highly complex, to answer questions about them, and to direct discussion of them.

Many high schools are offering advanced courses which are equivalent to freshman college courses. These enable the student to enter college with advanced standing. The high school science teacher must be prepared to instruct the capable students in advanced course offerings.

Much has been written about the training of science teachers at the college level. Smith¹³, (School of Education, University of Kansas), summarized the central recurring themes of these studies in the following three points:

- (1) A broad liberal education is essential for any person who is going to teach in any academic field. Teachers should be well-informed individuals.

¹³Herbert A. Smith, "Improving the Quality of Science Instructors in Elementary and Secondary Schools," American Journal of Physics, 27:261.

(2) Teachers need a reasonable grounding in the subject matter field. He proceeds to adopt the definition of "reasonable grounding" as given by the AAAS: "We recommend that the minimum requirements for academic subjects courses for science teacher's education be raised to such a level that the teacher has a reasonable mastery of his subject."

(3) Teachers need a certain amount of professional training.

In 1961 the AAAS in conjunction with the National Association of State Directors for Teacher Education and Certification interpreted these objectives in terms of college credits.¹⁴ (It should be pointed out that the number of credits earned in a given area is not always indicative of the quality of the teacher. The quality of the teacher's preparation cannot be overlooked.) Table I gives a summary of the suggested courses and credits in biology and other sciences for the preparation of high school biology teachers.

¹⁴Ibid, p. 1-16.

TABLE I

SUGGESTED COURSES IN BIOLOGY AND OTHER SCIENCES FOR
THE PREPARATION OF HIGH SCHOOL TEACHERS OF BIOLOGY

Subject	College Credits in Area					4-yr. total
	A Principles of biology	B Physiology, anatomy, and morphology	C Ecology and conser- vation	D Develop- ment, anatomy and ge- netics	E Biology materi- als for teachers	
Biology	10	10	4	5	4	33
Chemistry						10
Physics						8
Related Science						6
Mathematics						6
Total						63

The above table suggests that a biology teacher should earn a minimum of sixty-three hours in the science area. Thirty-three of these should be distributed among the various areas of biology. (See definitions of areas above.) This would leave approximately sixty hours to be earned in the areas of professional and general education. The AAAS-NASDTEC recommended that twenty of these hours be devoted to professional education and the remaining forty hours to general education.

The above preparation was designed to give the biology teachers: (1) scope and depth of training in the area of biology, (2) elements in professional education which should be helpful in giving performance in the classroom, and

(3) enough preparation in the social sciences and humanities to help give him the kind of perspective that we like the scholar and citizen to have.

METHODS AND PROCEDURES USED

Source of data. The data for this study were obtained from the State Department of Public Instruction in Topeka.

Methods of procedure. The names of all the biology teachers in Kansas who received their college degree in 1961, 1962, or 1963 were extracted from the 1963-64 High School Principal's Organizational Reports. The transcripts of those teachers were analyzed to determine the number of credits earned in biology, chemistry, physics, mathematics, related science, professional and general education.

Treatment of data. (1) The data were tabulated with due recognition to whether the teacher was a part-time science teacher, full-time science teacher, or a full-time biology teacher. (2) The data were tabulated according to school sizes: under 100, 101-200, 201-300, 301-750, 750---. (3) The data were categorized in terms of the areas in which the teacher had preparation. The areas of categorization were biology, chemistry, physics, mathematics, related science, professional education, and general education. (4) The biology field was analyzed as to whether

the courses were in areas A(Principles of Biology), B(Physiology, Anatomy and Morphology), C(Ecology and Conservation), D(Development, Anatomy and Genetics), and E(Biology Materials for Teachers).

ANALYSIS OF THE PROFESSIONAL AND ACADEMIC TRAINING

Academic preparation in biology. All of the 167 beginning biology teachers in this study received some academic training in biology. Their range of training was found to be from three to fifty-six hours. The average preparation for the part-time science teacher was 22.0 credits. The full-time science teacher received an average of 22.2 credits and the full-time biology teacher averaged 28.3 credits of preparation. Table II gives the number of credits earned in biology. Examination of the table reveals the following: (1) the collegiate preparation of forty-one or 24.8 per cent of the teachers included thirty-three or more hours in biology; this total includes thirteen or 18.1 per cent of the part-time science teachers, twenty-one or 27.6 per cent of the full-time science teachers, and seven or 41.2 per cent of the full-time biology teachers. (2) Eighty-seven or 52.6 per cent of the teachers had 18 or more credits in biology. Thirty-five or 40.2 per cent of the teachers having more than eighteen hours of preparation in biology are employed in schools with enrollments from 0-100.

TABLE II

* NUMBER OF CREDITS IN BIOLOGY EARNED BY PART-TIME AND FULL-TIME SCIENCE TEACHERS
AND FULL-TIME TEACHERS OF BIOLOGY ARRANGED ACCORDING TO SCHOOL SIZE

School Size	Number of Credits												Totals				
	O-Credits		1-8 Credits		9-17 Credits		18-33 Credits		33 Credits or More								
	PTS	FTB	PTS	FTB	PTS	FTB	PTS	FTB	PTS	FTB	PTS	FTB	PTS	FTB			
0-100	-	-	5	16	-	23	8	-	15	4	-	8	8	-	51	36	-
101-200	-	-	-	1	-	2	11	-	7	7	-	1	9	-	10	28	-
201-300	-	-	-	1	-	4	2	-	-	-	2	2	-	-	6	3	2
301-750	-	-	-	-	-	1	1	1	-	2	2	1	2	1	2	5	4
750----	-	-	-	1	-	-	-	1	2	1	4	1	2	6	3	4	11
Totals	-	-	5	19	-	30	22	2	24	14	8	13	21	7	72	76	17
	*		24=14.5%			54=32.6%			46=27.8%			41=24.8%			165		
Range in Credits 3-56 Ave. 22.0 22.2 28.3																	

PTS = Part-Time Science Teacher

FTS = Full-Time Science Teacher

FTB = Full-Time Biology Teacher

* AAAS Recommendation=33 Credits

The distribution of the biology credits earned by the beginning high school biology teachers is shown in Table III. The teachers received an average of 12.1 credits in courses dealing with principles of biology. The range in preparation for this area was from three to twenty-two credits. In area B, the teachers earned an average of 6.2 credits. Preparation for area B ranged from 0-23 credits. In area C, the teachers averaged 2.8 credits of preparation. Teachers received from 0-12 credits of preparation in this area. In the area of developmental anatomy and genetics, area D, the teacher received an average of 2.0 credits of preparation with a range from 0-6 credits. Sixty-nine per cent of the teachers did not receive any collegiate training in preparation and use of biological materials, area E. The average training in this area was 1.20 credits with a range from 0-6 credits.

Academic training in chemistry. (Table IV) There were 140 or eighty-four per cent of the 165 beginning biology teachers who had some preparation in chemistry. This group was made up of forty-seven or 66.6 per cent of the part-time science teachers, one hundred per cent of the full-time science teachers, and fifteen or 94.1 per cent of the full-time biology teachers. The range for those who had chemistry was 3 to 56 credits.

This study revealed that 46.7 per cent of the teachers earned ten or more credits in chemistry. Twenty-

TABLE III

AVERAGE DISTRIBUTION OF CREDITS EARNED BY PART-TIME
SCIENCE, FULL-TIME SCIENCE, AND FULL-TIME BIOLOGY
TEACHERS IN AREAS A, B, C, D, AND E

Type of Teacher	Principles of Biology	Credits of Biology in Area			
		Physiology, Anatomy and Morphology	Ecology and Conservation	Development Anatomy and Genetics	Biology Materials for Teachers
Part-time Science Teacher	10.1	6.5	2.3	2.4	0.7
Full-time Science Teacher	12.3	5.1	1.7	1.9	1.2
Full-time Biology Teacher	13.9	7.2	3.6	1.8	1.8
Average	12.1	6.2	2.8	2.0	1.2
Range of Credits 3-23		0-23	0-12	0-6	0-6

TABLE IV

NUMBER OF CREDITS IN CHEMISTRY* EARNED BY PART-TIME AND
FULL-TIME SCIENCE TEACHERS AND FULL-TIME TEACHERS
OF BIOLOGY ARRANGED ACCORDING TO SCHOOL SIZE

School Size	Number of Credits											
	0 Credits			1-9 Credits			10 Credits or more			Totals		
	PTS	FTS	FTB	PTS	FTS	FTB	PTS	FTS	FTB	PTS	FTS	FTB
0-100	18	-	-	20	16	-	13	20	-	51	36	-
101-200	6	-	-	2	6	-	2	22	-	10	28	-
201-300	1	-	1	5	1	-	-	2	1	6	3	2
301-750	-	-	-	-	3	2	2	2	2	2	5	4
750----	-	-	1	2	-	4	1	4	6	3	4	11
Totals	25	-	2	29	26	6	18	50	9	72	76	17
	27 = 15.7%			61 = 37.2%			77 = 46.7%			165		
Range of Credits = 3-56												
Ave. No. of Credits = 7.3 13.1 12.0												

PTS = Part-Time Science Teacher

FTS = Full-Time Science Teacher

FTB = Full-Time Biology Teacher

*AAAS Recommendation = 10 Credits

five per cent of the part-time science teachers had ten or more credits in chemistry. Sixty-five and eight-tenths per cent of the full-time science teachers had ten or more credits in chemistry and fifty-eight and eight-tenths of the full-time biology teachers had ten or more credits in chemistry.

The beginning biology teachers who included chemistry as a part of their academic background earned an average of 10.9 credits. The part-time science teachers earned an average of 7.3 credits. The full-time science teachers earned an average of 13.1 credits, and full-time biology teachers had an average of twelve hours in chemistry.

School sizes from 0-100 attracted 42.2 per cent of the beginning biology teachers with ten or more hours of preparation in chemistry.

Academic preparation in physics. (Table V) Physics was included in the academic preparation of eighty-three or 50.1 per cent of the beginning biology teachers; this total was composed of nineteen or 26.4 per cent of the part-time science teachers, fifty-eight or 76.5 per cent of the full-time science teachers, and six or 35.3 per cent of the full-time biology teachers. The range for those having physics was from 3 to 24 credits. Sixty-three or 38.1 per cent of the teachers had earned eight or more credits of training in physics. Among the seventy-two part-time teachers, there

TABLE V

NUMBER OF CREDITS IN PHYSICS* EARNED BY PART-TIME AND
FULL-TIME SCIENCE TEACHERS AND FULL-TIME TEACHERS
OF BIOLOGY ARRANGED ACCORDING TO SCHOOL SIZE

School Size	Number of Credits														
	0 Credits			1-7 Credits			8 Credits or more			Totals					
	PTS	FTS	FTB	PTS	FTS	FTB	PTS	FTS	FTB	PTS	FTS	FTB			
0-100	34	13	-	8	3	-	9	20	-	51	36	-			
101-200	10	3	-	-	5	-	-	20	-	10	28	-			
201-300	6	-	2	-	1	-	-	2	-	6	3	2			
301-750	-	-	2	-	1	-	2	4	2	2	5	4			
750----	3	2	7	-	-	2	-	2	2	3	4	11			
Total	53	18	11	8	10	2	11	48	4	72	76	17			
	82 = 49.7%			20 = 12.2%			63 = 38.1%			165					
Range of Credits = 3-24													Ave. No. of Credits = 5.4 10.3 1.7		

PTS = Part-Time Science Teacher

FTS = Full-Time Science Teacher

FTB = Full-Time Biology Teacher

*AAAS Recommendation = 8 Credits

were eleven or 15.3 per cent who had earned eight or more credits in physics. There were forty-eight or 63.1 per cent of the full-time science teachers who had earned eight or more credits in physics, and four or 23.4 per cent of the full-time biology teachers.

If a beginning biology teacher received any training in physics, he would have earned an average of 5.8 credits in that area; if he was a part-time teacher, he would have earned an average of 5.4 credits and if a full-time science teacher, an average of 10.3 credits. The full-time biology teachers earned an average of 1.7 credits in physics. Schools with enrollments under 100 attracted forty-six per cent of the biology teachers who had eight or more hours of preparation in physics.

Academic preparation in mathematics. (Table VI)

Mathematics was included in the academic preparation of 129 or seventy-eight per cent of the 165 beginning biology teachers. Although the range in the number of hours in mathematics was great, eighty-seven or 52.7 per cent of the teachers had earned a minimum of six credits. This total was made up of 8 per cent of the part-time science teachers, 66 per cent of the full-time science teachers and 35 per cent of the full-time biology teachers. The average number of credits included by the 129 who had preparation in mathematics is 12.1. The part-time science teacher had earned an average of 6.4 credits in mathematics. The

TABLE VI

NUMBER OF CREDITS IN MATHEMATICS* EARNED BY PART-TIME AND
FULL-TIME SCIENCE TEACHERS AND FULL-TIME TEACHERS OF
BIOLOGY ARRANGED ACCORDING TO SCHOOL SIZE

School Size	Number of Credits									Totals		
	0 Credits			1-5 Credits			5 Credits or more					
	PTS	FTS	FTB	PTS	FTS	FTB	PTS	FTS	FTB	PTS	FTS	FTB
0-100	18	5	-	20	-	-	13	31	-	51	36	-
101-200	4	2	-	3	4	-	3	22	-	10	28	-
201-300	1	-	1	3	-	-	2	3	1	6	3	2
301-750	-	1	1	2	2	1	-	2	2	2	5	4
750----	1	1	1	2	-	5	-	3	5	3	4	11
Totals	24	9	3	30	6	6	18	61	8	72	76	17
	36 = 21.8%			42 = 25.4%			87 = 52.7%			165		
Range of Credits = 0-52												
Ave. No. of Credits = 6.4 20 10.1												

PTS = Part-Time Science Teacher

FTS = Full-Time Science Teacher

FTB = Full-Time Biology Teacher

*AAAS Recommendation = 6 Credits

full-time science teacher earned an average of twenty hours and the full-time biology teacher received an average of 10.1 credits.

Schools with enrollments under 100 attracted 49.9 per cent of the biology teachers who had six or more credits in mathematics.

Academic preparation in related science. It is revealed in Table VII that 124 or 75.2 per cent of the beginning biology teachers had some academic preparation in related sciences. Only 26.6 per cent of the beginning biology teachers had received the AAAS recommendation of six or more credits in the related sciences. This total was made up of 30.6 per cent of the part-time science teachers, 27.6 per cent of the full-time science teachers and 6 per cent of the full-time biology teachers.

The teacher of biology who received academic preparation in related science had an average of 5.1 credits in related sciences. The range is from 3 to 16 credits. The part-time and full-time science teacher and the full-time biology teacher had averages of 6.1, 5.9, and 3.5 credits respectively.

Schools with enrollments under 100 attracted 59.1 per cent of the teachers who had earned more than six credits.

Preparation in professional and general education.

TABLE VII

NUMBER OF CREDITS IN RELATED SCIENCES* EARNED BY PART-TIME
AND FULL-TIME SCIENCE TEACHERS AND FULL-TIME TEACHERS
OF BIOLOGY ARRANGED ACCORDING TO SCHOOL SIZE

School Size	Number of Credits									Totals		
	0 Credits			1-5 Credits			6 Credits or more					
	PTS	FTS	FTB	PTS	FTS	FTB	PTS	FTS	FTB	PTS	FTS	FTB
0-100	12	10	7	22	17	4	17	9	-	51	36	4
101-200	1	6	-	5	14	-	4	8	-	10	28	-
201-300	1	1	-	4	1	1	1	1	1	6	3	2
301-750	1	-	1	1	3	3	-	2	-	2	5	4
750----	1	1	6	2	2	5	-	1	-	3	4	11
Totals	16	18	7	34	37	9	22	21	1	72	76	17
	41 = 24.8%			80 = 48.4%			44 = 26.6%			165		
Range of Credits = 3-16 Ave. No. of Credits = 6.1 5.9 3.5												

PTS = Part-Time Science Teacher

FTS = Full-Time Science Teacher

FTB = Full-Time Biology Teacher

*AAAS Recommendation = 6 credits

Table VIII shows that the average beginning biology teacher earned 23.7 credits in this area. All teachers received a minimum of twenty credits in professional education.

Table VIII shows that the beginning biology teachers earned an average of 59.7 hours of preparation in the area of general education. In all cases the teachers received a minimum of forty hours in general education.

CONCLUSIONS AND RECOMMENDATIONS

The results of this study support the following conclusions: full-time biology teachers were better prepared in the biological sciences than part-time and full-time science teachers. The full-time science teachers were better prepared in supporting courses of biology (chemistry, physics, mathematics, and related sciences) than part-time science and full-time biology teachers. Using the AAAS's recommendations for the college preparation of biology teachers, these additional conclusions were made from the results of this study.

(1) The larger schools (201--) attracted a greater percentage of high school biology teachers who earned the AAAS's college preparation recommendations than the smaller schools (under 100).

(2) Approximately one-half of the teachers of biology who came into the Kansas high schools during the past

TABLE VIII

AVERAGE NUMBER OF CREDITS IN PROFESSIONAL EDUCATION
AND GENERAL EDUCATION EARNED BY THE BEGINNING
BIOLOGY TEACHERS IN KANSAS

Area	Part-Time Science Teacher	Full-Time Science Teacher	Full-Time Biology Teacher	Ave.
Professional Education	23.3	23.0	25.0	23.7
General Education	65.5	54.4	59.2	59.7

three years (1961, 1962, and 1963) were insufficiently prepared in the biological sciences. (AAAS's minimum recommendation in biological sciences: 18 credits).

(3) The biological science preparation of the beginning biology teachers in Kansas was concentrated in the area of basic biological principles. There was a deficiency in scope and depth of the biological science preparation.

(4) Fifty-three and three-tenths per cent of the beginning high school biology teachers did not receive the recommended ten credits of college preparation in chemistry.

(5) Sixty-one and nine-tenths per cent of the beginning high school biology teachers did not receive the AAAS recommendation of 8 credits in physics.

(6) Forty-seven and two-tenths per cent of the beginning high school biology teachers did not receive the AAAS recommendation of six credits in mathematics.

(7) Seventy-three and two-tenths per cent of the beginning high school biology teachers did not earn the AAAS recommendation of six credits in related sciences.

(8) The beginning biology teachers received adequate preparation in professional and general education. (AAAS recommendations: professional education: 20 credits, general education: 40 credits.)

This study suggests that, in an effort to improve

the quality of biology teachers, colleges and universities should evaluate their teacher-education programs for prospective biology teachers. Consideration should be given to requirements regarding (1) the scope and depth of preparation in biology and (2) the type of preparation in the supporting fields of biology which include chemistry, physics, mathematics, and related sciences. Changes should be made to erase any apparent deficiencies in the above areas.

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APPENDIX

THE ACADEMIC AND PROFESSIONAL PREPARATION
OF THE BEGINNING HIGH SCHOOL BIOLOGY
TEACHERS IN KANSAS

by

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AN ABSTRACT OF A REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

School of Education

KANSAS STATE UNIVERSITY
Manhattan, Kansas

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The purpose of this study was to determine the nature and extent of the academic science, professional, and general education preparation of the beginning high school biology teachers in Kansas. And, to determine the relationship between the teachers' adequacy of college preparation and the size of schools in which they taught.

The American Association for the Advancement of Science's (AAAS) minimum recommendations for biology teacher preparation were used as criteria to determine the adequacy of preparation.

Data concerning the beginning high school biology teachers were obtained from the 1963-64 High School Principals' Organizational Reports and transcripts on file at the State Department of Public Instruction in Topeka.

This study indicated that schools with enrollments above one hundred attracted a greater percentage of the qualified science teachers than schools with enrollments from zero to one hundred.

The full-time biology teachers were better prepared in the biological sciences than the part-time and full-time science teachers. But, the full-time science teachers were better prepared in the supporting courses of biology, which include chemistry, physics, mathematics and related science.

Approximately one-half of the teachers did not earn the AAAS's minimum recommendation of eighteen credits in the biological sciences. Analysis of the teacher's biological

science training revealed that college preparation was concentrated in the area of basic biological principles. There was a lack of scope and depth in their college biology training.

The beginning biology teachers earned an average of 9.3 credits of college preparation in chemistry. Fifty-three and three-tenths per cent of the teachers did not earn the AAAS's recommendation of ten credits in chemistry. The teachers averaged 4.5 credits of college preparation in physics. Sixty-one and nine-tenths per cent of the teachers did not earn the eight credits in physics which were recommended by the AAAS. An average of 10.9 credits was earned in mathematics, and 47.2 per cent of the teachers did not earn the AAAS's recommendation of six credits. The teachers averaged 4.7 credits of preparation in the related sciences. Seventy-three and two-tenths per cent did not earn the AAAS's recommendation of six credits.

All of the teachers earned the recommended twenty credits in professional education and forty credits in general education.

Using the AAAS's recommendations for biology teacher preparation, it was concluded that many of the biology teachers who came into the Kansas high schools during the past three years were inadequately prepared at the college level. And, that the majority of the inadequately prepared teachers taught in schools with enrollments from 0-100.

There is a definite need in the State of Kansas to raise the level of preparation of the beginning biology teachers. This points out a need for colleges and universities to evaluate their teacher education programs for biology teachers, and for the State to examine the adequacy of its certification requirements.